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UNIVERSITY OF
SOUTH CAROLINA
College of Nursing

Impressions of Participants in a Chemical Mass Casualty Exercise

By: **Ethan Start**

*A thesis submitted for the degree of
Bachelor of Science*

University of South Carolina
South Carolina Honors College

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Impressions of Participants in a Chemical Mass Casualty Exercise

Abstract

A mass casualty exercise was performed to investigate triage and decontamination of patients exposed to an irritant gas. Nursing students participated in two groups: emergency department triage (ED) and decontamination (DECON). While participants felt overall that the experience was valuable, DECON participants had a greater interest in emergency response and were more likely to volunteer again.

Background

Mass casualty incidents present a unique challenge for healthcare personnel. A sudden surge of patients may overwhelm medical resources, resulting in critical patients not receiving adequate treatment¹. Training for such mass casualty scenarios has been termed an essential skill by the American Association of Collegiate Nursing². Furthermore, the NCLEX-RN Licensure Examination includes emergency response planning as a subset of safety and infection control spills³.

Chemical agents present further challenges to mass casualty triage. Industrial use of irritant gases requires the transportation of these chemicals throughout the United States^{4,5}. This raises the possibility of a chemical spill in a populated area, affecting many unsuspecting victims. Victims of chemical incidents require prompt decontamination to protect individuals, other waiting patients, and healthcare workers⁶. Decontamination puts further strain on an already stressed system in the event of a mass casualty incident.

A recent example of such an incident is the 2005 Graniteville chlorine spill. Two trains, one carrying chlorine, collided at 2:00 AM in downtown Graniteville, South Carolina. Chlorine fumes leaked from the derailed train and spread throughout the nearby town, killing nine people and sending hundreds to local emergency departments⁷. In response to this incident, a novel triage algorithm was developed specifically for Irritant Gas Syndrome Agents⁸. This algorithm incorporated findings from the Graniteville disaster, particularly by using oxygen saturation to predict severity of illness. A full-scale test of the new algorithm using simulated patients was necessary.

Several types of decontamination exist for the progressive stages of a mass contamination event. Emergency gross decontamination is used at the onset of an incident before more resources arrive. In emergency gross decontamination, patients remove outer clothing and are sprayed down outdoors with water. In contrast, technical decontamination involves the use of a decontamination tent, where victims can be washed down with water, scrub with soap, and dry off in separate contained stages⁶. Both emergency gross and technical decontamination methods were tested in this exercise.

Methods

On April 4th, 2017, the USC College of Nursing held a mass casualty triage exercise, using all junior and senior nursing students as mock patients, with three goals:

1. educating and preparing students for a mass casualty incident;
2. testing a new computerized triage algorithm intended for chemical mass casualty events;
3. testing the effectiveness of decontamination procedures.

This paper examines the impressions of the nursing students who participated in the exercise.

To accomplish the education objectives, the nursing students were required to complete several online training courses to prepare them for the mass casualty exercise. The students were required to complete courses in “Responder Health and Safety”¹¹ and “Mental Health Interventions in Disasters”¹⁰ from the North Carolina Institute for Public Health, as well as a pre-exercise quiz to demonstrate their comprehension of their role and objectives.

The nursing students were split into two groups prior to the exercise: Emergency Department (ED) and Decontamination (DECON). Students were given the option to ‘opt-out’ of the decontamination exercise. This exercise was exempt from IRB review since the students were ‘actors’ in the exercise and not research subjects. ED participants were used to test the new triage algorithm, whereas DECON participants were used to test the effectiveness of decontamination using a surrogate for a chlorine exposure. DECON participants were given the option to opt out of DECON and join ED instead. Furthermore, several additional DECON participants were re-tasked to join the ED on the day of the exercise.

The 294 ED participants were tasked with acting out the role of patients from the 2005 Graniteville chlorine spill, as an effort to test the Irritant Gas Syndrome Agent (IGSA) triage algorithm. Each participant was assigned a participant number and given a card detailing the demographic, symptoms, and vital signs of an actual patient from the 2005 disaster. All the ED participants waited in one room. The participants were scheduled to enter the simulated ED triage area in 15-minute intervals by the participant number. When the pre-assigned entry time arrived, the participants reported to the simulated emergency department triage area. The participants portrayed their assigned patient profile as they passed through a three-stage triage system. First, the patients were observed by triage nurses as they waited in line to use a kiosk. At the kiosk, the patients responded to questions about their symptoms and location and performed a quick oxygen saturation test using pulse oximetry (SpO₂). Finally, the patients reported to a triage nurse who questioned them further and took vital signs. The final triage assessment would then be made by the triage nurse, and the participant would return to the waiting area.

The 67 DECON participants were used to test the effectiveness of decontamination methods on airborne particles. An ultra-violet(UV)-fluorescent powder was used as a surrogate to model particles from an irritant agent. This powder was loaded into a high-pressure air cannon, and blasted onto DECON participants wearing standard blue t-shirts, slippers, safety goggles and surgical masks. Patients were then photographed in a darkened room under UV

light, which illuminated the powder. With the baseline established, the participants were then decontaminated by emergency gross or technical decontamination. In emergency gross decontamination, the patients just removed their shirts. In technical decontamination, patients proceeded through a tent, where they removed shirts, were sprayed down, and dried off in separate stages. After decontamination, patients were photographed again under UV light to determine contaminant removal.

After decontamination and triage procedures had been completed, all participants gathered for a debriefing on the event. During this, each participant was given a pencil and paper survey. The survey asked the following:

- What are the gender, age, race, and role of the participant?
- On a Likert scale, to what extent did the participant agree or disagree with 17 statements about the execution of the event?
- Depending on the role, which of the following problems were encountered?
- Describe any unanticipated issues.
- Describe the best part of their experience.
- Describe the worst part of their experience.
- Would the participant volunteer for another mass casualty exercise?

Data Analysis

A mixed methods approach was used to analyze the data. Data from the questionnaires were entered into an Excel spreadsheet for analysis. Descriptive and inferential statistical analysis was also performed using SAS/STAT® version 9.4.⁹ A thematic qualitative approach was used to analyze the open-ended questions.

Results

Demographics

There were 361 nursing student participants; 89% were ages 18-24, 5% 25-29, and 6% 30 or older. Ninety-three percent were female; 89% were white, 4% black, 4% more than one race, 1.7% Asian, and 1.5% other (Table 1). There were approximately 400 nursing students involved in the exercise; since there were 361 surveys submitted, at least 80% of participants were represented.

Table 1: Frequency of characteristics of the sample

Characteristic	n	%
Age		
18-24	322	90.45
25-29	19	5.34
30-39	9	2.53
40-59	4	1.12
60-69	2	0.56
Sex		
Female	329	92.94
Male	25	7.06
Race		
Asian	6	1.70
Black or African American	14	3.97
More than one race	14	3.97
Pacific Islander	1	0.28
Other	5	1.42
White or Caucasian	313	88.67
Ethnicity		
Hispanic or Latino	10	3.06
Not Hispanic or Latino	314	96.02
Prefer not to answer	3	0.92

Agree-Disagree Questions

Participants were presented with five possible answers to each prompt: Strongly Disagree, Disagree, Neither Agree nor Disagree, Agree, Strongly Agree. The five responses were assigned a numerical value from 1-5, 5 being Strongly Agree and 1 being Strongly Disagree. Since the ED and DECON participants had very different activities, the results of ED and DECON were compared (Table 2). The combined, ED, and DECON results were then averaged for each prompt. A t-test was then performed to determine if there was a statistically significant difference between ED and DECON for each prompt. The DECON group reported statistical higher scores ($p < 0.05$) than the ED group in response to “The experience was valuable” and “The experience peaked an interest in Emergency Response” (4.21 vs 3.87; 4.00 vs 3.75).

Table 2: Likert scale responses. 5 means Strongly Agree, 1 means Strongly Disagree. Mean, Standard Deviation, p value comparing ED vs DECON.

Variable	n	M	SD	p Value
The Pre-Exercise email was helpful				0.160
DECON	67	4.30	0.66	
ED	291	4.16	0.76	
The parking directions were clear				0.743
DECON	67	3.82	1.03	
ED	292	3.87	0.99	
A parking space was easily located				0.170
DECON	67	4.06	1.01	
ED	294	4.24	0.75	
The registration area was easily located				0.226
DECON	67	4.45	0.70	
ED	294	4.34	0.67	
Registration was efficient				0.100
DECON	67	4.023	1.03	
ED	294	3.80	1.03	
The information in the registration packet was helpful				0.279
DECON	67	4.15	0.96	
ED	294	4.28	0.60	
The information in the Job Action Sheet was easily understood				0.707
DECON	67	4.22	0.62	
ED	292	4.26	0.65	
The Just In Time training was adequate				0.907
DECON	67	4.33	0.59	
ED	292	4.32	0.63	
The safety briefing was adequate				0.722
DECON	67	4.40	0.58	
ED	289	4.37	0.61	
The information on the Patient Card was clearly understood				0.0015
DECON	66	4.12	0.80	
ED	290	4.42	0.67	
The staff was easily identified				0.975
DECON	67	4.46	0.59	
ED	288	4.47	0.62	
Help was available and immediately accessible				0.551
DECON	67	4.48	0.53	
ED	288	4.43	0.64	
Communication was effective				0.463
DECON	67	4.21	0.83	
ED	287	4.28	0.69	
The experience was valuable				0.0023
DECON	67	4.21	0.73	
ED	287	3.87	1.02	
The experience piqued an interest in Emergency Response				0.040
DECON	67	4.00	0.85	
ED	286	3.75	1.06	
The food and beverages were adequate				0.681
DECON	67	4.31	0.72	
ED	284	4.35	0.69	
The breaks were adequate				0.231
DECON	67	4.24	0.76	
ED	279	4.35	0.70	

Reported Issues

In the survey, the participants were presented with several potential problems based on their role and were asked to mark which of the problems they had encountered (Table 3). The most frequent issues in the Emergency Department were “getting started” and “scanning the barcode” (20.4% and 10.2%). Only 2.4% reported having issues summoning help when needed. Among the Decontamination group, the most frequent complaints were “adequacy of slippers” and “getting started” (37.3% and 19.4%).

Table 3: Frequency of reported issues.

Emergency Department (n=294)		Decontamination (n=67)	
Problem	n (%)	Problem	n (%)
Getting Started	60 (20.4)	Adequacy of slippers	25 (37.3)
Scanning the bar code	30 (10.2)	Getting Started	13 (19.4)
Entering address using Google Maps	23 (7.8)	Being photographed	9 (13.4)
Interpreting the card	22 (7.5)	Other	8 (11.9)
Navigating through the tablet screens	22 (7.5)	Appearing on station on time	4 (6.0)
Technical issues with the tablet	22 (7.5)	Securing personal items	4 (6.0)
Entering data from the patient card	14 (4.8)	Availability of towels	3 (4.5)
Using the pulse oximeter	13 (4.4)	Problems with Doffing	2 (3.0)
Other	11 (3.7)	Problems with Technical Decon	2 (3.0)
Summoning help when needed	7 (2.4)	Being sprayed with Glo Germ	1 (1.5)
		Problems with Emergency Decon	1 (1.5)
		Following firefighter instructions	1 (1.5)
		ID Sheet Being Photographed	0 (.0)
		Problems with use of safety equipment	0 (.0)

Thematic Analysis

A mixed methods approach was used to analyze the open-ended responses. Patients were asked what their best experience was, what their worst experience was, and any unanticipated issues they encountered. Due to a large overlap in the responses between the two questions, “worst experience” was combined with “unanticipated issues.” A qualitative analysis was performed first: all responses were read to generate a list of themes (Table 4). Then, each participant’s response was tagged with all relevant themes. For example, a participant said her worst experience was “being cold waiting to get photographed after [being] sprayed.” The themes “wait” and “undress” were applied, since the participant complained about waiting and being cold or underdressed. A quantitative analysis was then performed by determining the incidence and frequency of each theme in the two groups. One response could have multiple themes; therefore, percentages do not total to 100%.

Table 4: Themes from free response questions comparing DECON and ED group by number and percent.

Best experience	ED (294) n (%)	DECON (67) n (%)	Explanation
People	21 (7.14)	10 (14.93)	Enjoyed hanging out with fellow students, faculty, and staff
Fun	0 (.00)	4 (5.97)	Stated they had fun
DECON	1 (.34)	24 (35.82)	Enjoyed the DECON procedures
Organization	23 (7.82)	3 (4.48)	Commented on good or speedy execution
Learning	33 (11.22)	14 (20.90)	Enjoyed learning about triage or decon procedures
Research	13 (4.42)	1 (1.49)	Enjoyed being a part of research
Acting	49 (16.67)	0 (.00)	Enjoyed acting
Stadium	22 (7.48)	1 (1.49)	Enjoyed being in Williams-Bryce Stadium
Complaints	ED	DECON	Explanation
Wait	204 (69.39)	41 (61.19)	Disliked waiting around
Undress	0 (.00)	30 (44.78)	Disliked being cold and wet, or insufficient clothing
Hot	0 (.00)	2 (2.99)	Felt hot outside
App	23 (7.82)	0 (.00)	Had issues with the app
Internet	2 (.68)	1 (1.49)	Unable to upload assignment to the internet
Role	13 (4.42)	1 (1.49)	Didn't understand or unexpected change of role
Not Disaster	8 (2.72)	0 (.00)	Not enough participation or realism
Packet	13 (4.42)	2 (2.99)	Packet instructions inadequate
Not Credit	11 (3.74)	0 (.00)	Wanted additional credit for another curriculum requirement
Mandatory	5 (1.70)	0 (.00)	Didn't feel exercise should have been mandatory
Acting	11 (3.74)	0 (.00)	Didn't like acting

Volunteering Again

Finally, participants were asked if they would volunteer for a mass casualty exercise or drill and given the option to check “yes” or “no.” 84% of DECON participants marked “yes,” as opposed to 56% of ED participants (Table 5). A Chi-Square test comparing the two groups showed statistical significance, yielding a p-value less than 0.01 ($p = 0.0003$).

Table 5: Yes/No responses to being asked if the participant would volunteer for another mass casualty exercise.

	Would you volunteer for another mass casualty exercise or drill?	
	Yes (%)	No (%)
ED (269)	165 (61.34%)	104 (38.66%)
DECON (66)	56 (84.85%)	10 (15.15%)

Discussion

Likert Scale Prompts

In response to the “experience was valuable” and “piqued an interest in emergency response” prompts, both the DECON and ED groups gave positive average answers: 4.21 and 4.00 for DECON, 3.87 and vs 3.75 for ED. However, the ED group showed a statistically lower ($p = 0.0023$; $p = 0.040$) response compared to the DECON group in both areas.

Reported Issues

The most frequently checked issue (37%) for the DECON group was “adequacy of slippers.” DECON participants were issued stick-on slippers to prevent their shoes from being damaged by the water. Clearly, the slippers were inadequate, and frequently fell off. About 20% of both ED and DECON reported issues getting started; a significant amount of time was required to register all 361 participants, train them, and queue them for triage or decontamination. Issues reported by the ED group regarding the tablet have been reported to the developers of the kiosk app for further investigation.

Thematic Analysis

For the ED participants, the favorite activity was acting out the various roles and symptoms of their assigned patients. The DECON participants said that their favorite experiences were experiencing (36%) and learning about (21%) decontamination. In addition, participants mentioned that they enjoyed spending time with classmates and seeing Williams-Bryce Stadium. By far, the worst experience for participants was the waiting (68%). The participants waited for 1) registration; 2) triage or decontamination; 3) food; and 4) the end of the exercise. This is due to the large-scale nature of the exercise; with 360 student participants, plus faculty and staff, waiting was inevitable. 45% of the DECON said their worst experience involved being cold and wet after being hosed down. This was essential to the DECON process, and only 3 people mentioned lack of towels.

Conclusion

Overall, the participants found the experience valuable, and enjoyed learning about triage and decontamination, spending time with friends, and seeing the stadium. DECON participants

became cold and wet and ED participants had to wait; however, these are both realistic parts of a mass casualty scenario. DECON participants reported statistically significantly higher responses than ED participants to “the experience was valuable,” “the experience piqued an interest in Emergency Response” and “would you volunteer for another mass casualty exercise.” It is hypothesized that the lower waiting times and more physical activities for the DECON group resulted in higher interest.

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Appendix A: Survey distributed to participants

4 April 2017 Exercise Questionnaire

Page 1 of 4

INSTRUCTIONS - All participants should complete all sections. In the **ROLE SPECIFIC SECTION**, only answer questions for the role you held during the exercise. Most participants were assigned a single role.

DEMOGRAPHICS - applies to all

Age Bracket
(Age in years on April 4, 2017)

☐ < 17 ☐ 18-24 ☐ 25-29 ☐ 30-39 ☐ 40-49 ☐ 50-59 ☐ 60-69 ☐ >=70

Gender

☐ Female ☐ Male

Race

☐ White or Caucasian
☐ Black or African American
☐ American Indian or Alaska Native
☐ Asian
☐ Native Hawaiian or Other Pacific Islander
☐ Other
☐ More Than One Race

Ethnicity

☐ Not Hispanic or Latino ☐ Hispanic or Latino ☐ Unknown ☐ Prefer not to answer

EXERCISE - applies to all

Location

☐ Emergency Department (ED) ☐ DECON ☐ Other

Role

☐ ED Patient
☐ DECON Patient
☐ Triage Nurse (Supervisor, Primary, Secondary)
☐ Observer
☐ Kiosk Helper
☐ Concerns and Safety Assistant
☐ Expediter
☐ Faculty Student Supervisor
☐ Nursing Staff
☐ ROTC
☐ Other

Have you previously participated in a mass casualty or disaster drill?

☐ Yes ☐ No

Please, select one response for each question - applies to all.

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
The Pre-Exercise email was helpful	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The parking directions were clear	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
A parking space was easily located	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

The registration area was easily located	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Registration was efficient	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The information in the registration packet was helpful	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

The information in the Job Action Sheet was easily understood	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

The Just In Time training was adequate	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The safety briefing was adequate	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

The Information on the Patient Card was clearly understood	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The staff was easily identified	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Help was available and immediately accessible	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Communication was effective	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The experience was valuable	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The experience peaked an interest in Emergency Response	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

The food and beverages were adequate	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The breaks were adequate	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

ROLE SPECIFIC SECTION - only answer questions for the role you held during the exercise.

Most participants were assigned a single role.

ED PATIENT: Select any problem you encountered
(Check all that apply)

- ☐ getting started
- ☐ scanning the bar code
- ☐ interpreting the card
- ☐ navigating through the tablet screens
- ☐ entering data from the patient card
- ☐ using the pulse oximeter
- ☐ entering address using Google maps
- ☐ summoning help when needed
- ☐ using the tablet (technical issues)
- ☐ other

DECON PATIENT: Select any problem you encountered
(Check all that apply)

- ☐ getting started
- ☐ ID sheet being photographed
- ☐ being photographed
- ☐ appearing on station on time
- ☐ being sprayed with Glo Germ
- ☐ problems with Doffing
- ☐ problems with Emergency Decon
- ☐ problems with Technical Decon
- ☐ following firefighter instructions
- ☐ problems with use of safety equipment (PPE)
- ☐ securing personal items
- ☐ availability of towels
- ☐ adequacy of slippers
- ☐ other

PRIMARY TRIAGE NURSE: Select any problem you encountered
(Check all that apply)

- ☐ conducting rapid visual assessment (size-up)
- ☐ handing-off to Supervisor Nurse those patients needing immediate help
- ☐ receiving help when needed
- ☐ taking breaks when needed
- ☐ other

SECONDARY TRIAGE NURSE: Select any problem you encountered
(Check all that apply)

- ☐ getting started
- ☐ scanning the bar code
- ☐ patient data appearing in timely manner
- ☐ validating patient name, dob, address, SpO2, pulse
- ☐ assessing respirations
- ☐ entering respirations from card
- ☐ conducting rapid nursing assessment
- ☐ agreeing/disagreeing with exposure/action assessment
- ☐ entering justification if disagree with exposure/action assessment
- ☐ navigating through the tablet screens
- ☐ summoning help when needed
- ☐ using the tablet (technical issues)
- ☐ taking breaks when needed
- ☐ other

SUPERVISOR NURSE: Select any problem you encountered
(Check all that apply)

- ☐ responding timely to request for help
- ☐ scanning the bar code
- ☐ interpreting the card
- ☐ navigating through the tablet screens
- ☐ entering name and date of birth from the patient card
- ☐ summoning help when needed
- ☐ assessing patient as IMMEDIATE
- ☐ using the tablet (technical issues)
- ☐ difficulty managing multiple patients needing IMMEDIATE help
- ☐ difficulty switching out nurses for breaks
- ☐ difficulty adding more nurses to secondary triage during surge
- ☐ difficulty providing help when needed
- ☐ difficulty managing bottlenecks
- ☐ taking breaks when needed
- ☐ other

DECON OBSERVER: Select any problem you encountered
(Check all that apply)

- ☐ problems with iPad (technical issues)
- ☐ not enough time to enter each observation
- ☐ photographing contaminated victims
- ☐ problems with Doffing
- ☐ problems with Emergency Decon
- ☐ problems with Technical Decon
- ☐ following firefighter instructions
- ☐ taking breaks when needed
- ☐ other

KIOSK / PRIMARY NURSE / SECONDARY NURSE /
SUPERVISOR NURSE OBSERVER: Select any problem you
encountered
(Check all that apply)

- ☐ problems with iPad (technical issues)
- ☐ not enough time to enter each observation
- ☐ taking breaks when needed
- ☐ other

FACULTY SUPERVISORS: Select any problem you
encountered
(Check all that apply)

- ☐ engaging students in discussion related to journal
entries
- ☐ assisting students to complete Journals
- ☐ assuring the safety of all students
- ☐ assuring no pictures were taken on cell phones
- ☐ assuring students were where they needed to be
during the various phases of the Exercise
- ☐ other

EXPEDITER: Select any problem you encountered
(Check all that apply)

- ☐ assuring the safety of all students
- ☐ assuring students were where they needed to be
during the various phases of the Exercise
- ☐ taking breaks when needed
- ☐ other

CONCERNS AND SAFETY ASSISTANTS: Select any problem
you encountered
(Check all that apply)

- ☐ documenting concerns / safety issues
- ☐ deciding which concerns / safety issues need to be
shared
- ☐ communicating concerns /safety issues to
appropriate point of contact
- ☐ taking breaks as needed
- ☐ other

Describe why you checked "Other"
(Role Specific problem)

GENERAL - applies to all

Please describe any unanticipated issues you
encountered

Describe the BEST part regarding your experience
during the exercise.

Describe the WORST part regarding your experience
during the exercise.

Would you volunteer for another mass casualty
exercise or drill?

☐ Yes ☐ No